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ABSTRACT

The purpose of this follow-up study was to determine whether changes in teacher high-level questioning behavior and classroom interaction patterns (rates of pupil and teacher talk) which resulted from the use of operant methodology in a microteaching setting were maintained during the student teaching experience a year later. Twenty University of Minnesota juniors who were preparing to be secondary school science teachers were randomly assigned to a control group or one of two experimental groups. Each subject taught 10-minute lessons on one of three topics: color, heat transfer, or simple machines. On the basis of audiotapes of the lessons, questions were categorized as low and high level and rates of pupil and teacher talk determined. Fourteen of the original group completed their student teaching experience and participated in the follow-up study. Each student teacher audiotaped several of what they considered to be their best class sessions. These tapes were analysed for rates of low and high level questions, pupil-initiated content questions, and pupil and teacher talk. Results of the study illustrated the usefulness of operant methodology in teacher education as a means for changing teacher behavior. These behavioral changes were found to be stable over a 1-year period. (MJM)

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STABILITY OF BEHAVIORAL CHANGE - ONE YEAR AFTER PRECISION MICRO - TEACHING

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Stability of Behavioral Change - One Year
After Precision Micro - Teaching

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The purpose of the follow-up study[1] was to determine whether the changes in teacher high-level questioning behavior and classroom interaction patterns (rates of pupil and teacher talk) which resulted from the utilization of operant methodology in a micro-teaching setting were maintained during the student teaching experience a year later.

The subjects in the original study were twenty University of Minnesota College of Education juniors who were preparing to be secondary school science teachers. All were enrolled in a five-credit course in educational psychology and a one-credit science methods course during Spring 1970. The group was composed of sixteen males and four females. One-half were preparing to teach in the physical sciences (chemistry, physics, and earth science), the other half in the biological sciences.

Subjects were randomly assigned to one of three treatment groups: a control group (C) of six and two experimental groups (E1 and E2) of seven subjects each.

Each subject taught a unit of ten, ten-minute micro-lessons on one of three assigned topics from the physical sciences: color, heat transfer, or simple machines. Each subject taught the same group of four seventh graders

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[1]The original paper, "Precision Micro-Teaching" presented at 1971 AERA Annual Meeting, was based on a Ph.D. study conducted at the University of Minnesota under the direction of Daniel C. Neale currently at the University of Delaware.

Boeck, Marjorie A. Experimental Analysis of Questioning Behavior of Pre-Service Secondary School Science Teachers. Ph.D. Dissertation. University of Minnesota, December 1970. (Unpublished)

or six eighth graders for each lesson. Subjects were given a short description of the types of concepts that could be covered within their assigned topic. Demonstrations and experiments were encouraged, but students were given complete freedom to plan their own series of lessons. Each lesson was audiotaped and subjects were assigned a time in which to listen to the audio playback of their lessons.

Following the first five micro-lessons, the first experimental group (E1) of seven subjects received the experimental treatment, which consisted of a forty-five minute training session focused on questioning behavior. Following the seventh lesson, the second experimental group (E2) of seven subjects participated in an identical training session. The third group of six subjects served as a control group (C) and did not participate in the training session.

During the forty-five minute training session, subjects were taught to categorize questions according to definitions derived from the Bloom taxonomy. Low level questions were classified as those requiring simple memory or translation while high level questions were those involving application, analysis, synthesis, or evaluation.

Subjects were told to concentrate their teaching efforts in the remaining microteaching sessions on asking questions of their pupils which required more than rote memory for a correct response. They were asked to categorize their questioning behavior using the audiotape of their daily lesson and to graph the frequency of high level questions asked during each teaching period.

Typescripts of all teacher questions were made from the audiotapes to facilitate the categorization process. Two raters, one of whom was the investigator, categorized each of the questions independently. The raters

then reached consensus on the categorization of each question. For the final analysis, the five categories were collapsed into two categories (low level and high level). The number of high level questions asked was divided by the number of minutes taught to obtain the rate of high level questions asked per minute. The same procedure was followed to obtain the rate of low level questions asked per minute.

The measures of rates of pupil and teacher talk were obtained from the audiotapes by running one electric timer while the teacher was talking and one electric timer while the pupils were talking during two-minute intervals. No timer was in operation during periods of silence. Rates of pupil talk in seconds per minute were then determined by dividing the number of seconds of pupil talk by the number of minutes in the lesson. The same procedure was followed to determine the rate of teacher talk in seconds per minute.

Information about the effectiveness of the treatment for individual subjects was obtained by studying graphs for each subject which showed the rates for each of the four variables for each of the ten lessons.

A comparison of individual subject graphs indicated the treatment was not equally effective for all experimental subjects. In general, the rates of high level questioning and pupil talk increased while the rate of teacher talk decreased. No consistent pattern was observed for the rate of low level questioning following treatment. No clear changes in rates were observed for the control subjects.

The results of the individual subject analysis were substantiated by group analyses of the data. The group design utilized a one-way analysis of variance for each of the ten microlessons. To test the hypothesis that

there was no difference among the three groups prior to any treatment, an overall F test was calculated for each dependent variable for each of the first five days. No significant differences were found.

A planned comparison was used on the data for lessons six and seven to test the null hypothesis that there was no difference between the treated group and the two untreated groups. The treated group had a significantly lower rate of teacher talk and significantly higher rates of high level questioning and pupil talk. There were no significant differences between groups in the rate of low level questioning.

Two orthogonal contrasts were used to test for differences in the rates of the four dependent variables between the treated and untreated groups and between the two treated groups for lessons eight, nine, and ten. The treated groups were found to ask high level questions at a higher rate, to have a higher rate of pupil talk, and a lower rate of teacher talk. There were no significant differences among the three groups on the rates of the four dependent variables.

During the 1970-1971 school year, only fourteen of the twenty students in the original study completed a student teaching experience. Four of the six who did not teach had been in the control group. Three students performed all nine quarter credits of student teaching during the fall quarter. Eight of the eleven remaining students, those who student taught during the winter or spring quarters, participated in the study. Five of the students taught in the physical sciences while the remainder taught biological sciences. The schools in which the students taught varied in location from the inner-city to the suburbs. Students taught either for a half or a full day under regular or modular scheduling. Each student teacher audiotaped several class sessions. They were given no specific instructions except that they should attempt to provide examples

of what they considered to be their "best" teaching. The investigator had no personal contact with the students during their senior year.

Typescripts were made of the audiotaped lessons and the questions categorized as before into "low" and "high" level. Rates of low level and high level questions asked per minute, as well as the rate of pupil initiated content questions asked per minute, were determined for each student. Rates of pupil and teacher talk were also determined.

For each subject the rates for each of the four variables during student teaching were compared with the rates determined for the ten microlessons. The results for each subject will be discussed separately. Tables I - IV show the rates from the follow-up study as well as the mean rates and range for each of the four variables before and after treatment.

Two of the subjects (C-3 and C-5) were members of the control group. Subject C-3 showed no shift in rate for any of the four variables across the ten microlessons. One year later the rates of high and low level questioning and pupil talk remained at baseline levels. The rate of teacher talk was slightly higher. Subject C-5 showed no shift in rate across the ten sessions for high or low level questioning or teacher talk. This subject was the only one of the control group to show a marked increase in the rate of pupil talk during sessions nine and ten. One year later the rates of high level questioning and teacher talk remained at baseline levels while rates of low level questioning and pupil talk increased.

Four of the subjects in the follow-up study were members of the first experimental group (E-1) and trained after five microlessons.

Subjects E-3, E-5, E-6, and E-7 showed increases in the rates of high and low level questioning and pupil talk, and decreases in the rate of teacher talk following treatment.

All four subjects maintained their rate of high level questioning at post-treatment levels during student teaching. For subjects E-3, E-5, and E-6 the post-treatment mean was exceeded. The rate of low level questioning was more variable: above the post-treatment mean for subjects E-5 and E-6, and below the mean for subjects E-3 and E-7.

Subjects E-3, E-5, and E-6 all showed a rate of pupil talk above the post-treatment mean and range while subject E-7 maintained the post-treatment rate. For all four subjects the rate of teacher talk returned to the pre-treatment levels.

Two of the subjects in the follow-up study were part of the second experimental group (E-2) and trained after the seventh microlesson.

Both subject E-8 and E-11 showed an unstable increase in the rate of high level questioning and no change in the rate of low level questioning following treatment. There was an increase in the rate of pupil talk. Subject E-8 showed no change in the rate of teacher talk while there was a decrease in teacher talk for subject E-11.

The rate of high level questioning during student teaching returned to the maximum level which occurred immediately after treatment and had not been maintained. The level of low level questioning dropped below the post-treatment mean. Subject E-8 maintained the post-treatment increase in pupil talk while for subject E-11 the rate returned to pre-treatment levels. The rate of teacher talk returned to the pre-treatment range for both subjects.

Despite the small sample size, a two sample t-test was used to test for differences between the means of the control and experimental groups on the four dependent variables. See Tables V and VI. The rate of high level questioning was significantly higher for the experimental group. There were no significant differences between groups for the other variables.

Discussion

The study was designed to determine whether students whose classroom behavior changed by applying "precision teaching" strategies in micro-teaching maintained these behaviors during student teaching.

All of the experimental subjects maintained their rate of high level questioning. For two subjects, the rate of high-level questioning exceeded the post-treatment rate. No appreciable differences could be attributed to the content covered in the lessons or to the time at which the experimental treatment had been given (after five or seven microlessons). The control subjects showed no change in high level questioning.

Rates of low-level questioning, as in the original study, followed no consistent pattern. Rates increased above the post-treatment mean for two subjects and decreased for four subjects.

For five of the six experimental subjects, the increase in the rate of pupil talk was maintained. For three of these subjects the rate exceeded the post-treatment maximum. The rate of teacher talk returned to pre-treatment levels for all experimental subjects. This was, in part, the result of a decrease in the amount of silence (no pupil or teacher talk).

The rate of pupil initiated content questions was fairly constant for all experimental subjects ranging from 0.56 to 0.90. The single exception was subject E-11 with a rate of only 0.08 questions. Rates of all five variables were remarkably consistent across lessons for the individual subjects.

Results of the study illustrate the usefulness of operant methodology in teacher education as a means for changing teacher behavior. These behavioral changes were found to be stable over a one year period.

TABLE I. HIGH LEVEL QUESTIONING DATA FOR INDIVIDUAL SUBJECTS

SUBJECT	RANGE BEFORE[a] TREATMENT (?/min.)	MEAN RATE[b] BEFORE TREATMENT (?/min.)	RANGE AFTER TREATMENT (?/min.)	MEAN RATE AFTER TREATMENT (?/min.)	RATE (?/min.) STUDENT TEACHING
C-3	0.20-2.00	1.04	-----	----	0.00
C-5	0.00-0.75	0.26	-----	----	0.07
E-3	0.00-0.25	0.12	0.38-1.37	0.93	2.20
E-5	0.00-0.90	0.20	1.17-1.90	1.52	1.68
E-6	0.00-0.50	0.21	1.80-2.40	2.12	2.00
E-7	0.12-1.70	1.05	0.38-2.75	1.63	2.30
E-8	0.00-0.40	0.16	0.00-0.70	0.47	1.36
E-11	0.12-1.20	0.52	0.60-2.28	1.57	1.24

[a] A single range is reported for control subjects

[b] A single mean rate is reported for control subjects

TABLE II. LOW LEVEL QUESTIONING DATA FOR INDIVIDUAL SUBJECTS

SUBJECT	RANGE BEFORE[a] TREATMENT (?/min.)	MEAN RATE[b] BEFORE TREATMENT (?/min.)	RANGE AFTER TREATMENT (?/min.)	MEAN RATE AFTER TREATMENT (?/min.)	RATE (?/min.) STUDENT TEACHING
C-3	0.30-1.20	0.63	-----	----	1.13
C-5	0.00-1.17	0.42	-----	----	1.37
E-3	0.00-0.70	0.29	0.20-1.62	0.87	0.40
E-5	0.40-1.20	0.85	0.80-2.50	1.56	1.80
E-6	0.00-0.90	0.41	0.80-1.00	0.88	1.43
E-7	0.50-2.20	1.42	1.10-2.75	1.67	0.10
E-8	0.10-1.40	0.85	1.40-2.72	1.94	0.28
E-11	0.40-1.50	0.90	0.72-1.00	0.88	0.40

[a]A single range is reported for control subjects

[b]A single mean is reported for control subjects

TABLE III: PUPIL TALK DATA FOR INDIVIDUAL SUBJECTS

SUBJECT	RANGE BEFORE[a] TREATMENT (sec./min.)	MEAN RATE[b] BEFORE TREATMENT (sec./min.)	RANGE AFTER TREATMENT (sec./min.)	MEAN RATE AFTER TREATMENT (sec./min.)	RATE (sec./min.) STUDENT TEACHING
C-3	1-23	8	-----	----	6
C-5	1-6	3	-----	----	24
E-3	0-4	2	4-9	7	25
E-5	2-3	2	9-22	14	24
E-6	1-5	2	16-18	17	25
E-7	1-7	5	12-20	16	14
E-8	2-8	5	12-15	14	13
E-11	2-10	5	16-20	18	7

[a] A single range is reported for control subjects

[b] A single mean is reported for control subjects

TABLE IV: TEACHER TALK DATA FOR INDIVIDUAL SUBJECTS

SUBJECT	RANGE BEFORE[a] TREATMENT (sec./min.)	MEAN RATE[b] BEFORE TREATMENT (sec./min.)	RANGE AFTER TREATMENT (sec./min.)	MEAN RATE AFTER TREATMENT (sec./min.)	RATE (sec./min.) STUDENT TEACHING
C-3	18-45	31	------	-----	46
C-5	18-40	30	------	-----	33
E-3	32-49	40	17-40	26	34
E-5	35-43	39	13-26	19	39
E-6	25-42	36	16-22	20	41
E-7	26-38	31	19-23	21	35
E-8	19-39	32	21-29	25	38
E-11	31-45	38	19-28	25	52

[a]A single range is reported for control subjects

[b]A single mean is reported for control subjects

TABLE V. COMPARISON OF GROUP MEANS: TWO-TAILED T-TEST

GROUP	RATE OF HIGH LEVEL QUESTIONS PER MINUTE	RATE OF LOW LEVEL QUESTIONS PER MINUTE
Control		
Mean	.035	1.25
Experimental		
Mean	1.797	0.735
t-value	5.355	0.981
P	$< .002$	n.s.

TABLE VI: COMPARISON OF GROUP MEANS: TWO-TAILED T-TEST

GROUP	RATE OF PUPIL TALK (seconds/minute)	RATE OF TEACHER TALK (seconds/minute)
Control		
Mean	15	39
Experimental		
Mean	18	40
t-value	0.426	0.090
P	n.s.	n.s.